CLAIMS

The invention claimed is:

1. An atomic layer deposition method of forming a silicon dioxide comprising layer on a substrate, comprising:

positioning a substrate within a deposition chamber;

flowing trimethylsilane to the chamber and flowing a first inert gas to the chamber under conditions effective to chemisorb a first species monolayer comprising silicon onto the substrate, the first inert gas flowing being at a first rate;

after forming the first species monolayer, flowing an oxidant to the chamber and flowing a second inert gas to the chamber under conditions effective to react the oxidant with the chemisorbed first species and form a monolayer comprising silicon dioxide on the substrate; the second inert gas flowing being at a second rate which is less than the first rate; and

successively repeating said a) trimethylsilane and first inert gas flowing and b) oxidant and second inert gas flowing effective to form a silicon dioxide comprising layer on the substrate.

2. The method of claim 1 wherein second rate is no more than 50% of the first rate.

3. The method of claim 1 wherein second rate is no more than 40% of the first rate.

4. The method of claim 1 wherein second rate is from 25% to 50% of the first rate.

5. The method of claim 1 wherein second rate is from 25% to 40% of the first rate.

6. The method of claim 1 wherein second rate is from 30% to 40% of the first rate.

7. The method of claim 1 wherein second rate is from 35% to 40% of the first rate.

8. The method of claim 1 wherein the first and second inert gases are the same.

9. The method of claim 1 wherein the first and second inert gases are the different.

10. The method of claim 1 wherein each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 2 Angstroms.

11. The method of claim 1 wherein each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 3 Angstroms.

12. The method of claim 1 wherein the oxidant is flowed to the reactor at a rate of at least 2000 sccm.

13. The method of claim 1 wherein the oxidant is flowed to the reactor at a rate of at least 3000 sccm.

14. The method of claim 1 wherein the oxidant is flowed to the reactor at a rate of at least 4000 sccm.

15. The method of claim 1 wherein the oxidant is flowed to the reactor at a rate of at least 5000 sccm.

16. The method of claim 1 wherein the oxidant flowing is void of plasma within the chamber.

17. The method of claim 1 wherein second rate is from 35% to 40% of the first rate, each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 3 Angstroms, and the oxidant is flowed to the reactor at a rate of at least 2000 sccm.

18. The method of claim 1 wherein said trimethylsilane flowing is for a first time period and said oxidant flowing is for a second time period, the second time period being longer than the first time period.

19. The method of claim 18 wherein the second time period is at least twice as long as the first time period.

20. The method of claim 18 wherein the second time period is more than 2.5 seconds, and the first time period is no greater than 2.5 seconds.

21. An atomic layer deposition method of forming a silicon dioxide comprising layer on a substrate, comprising:

positioning a substrate within a deposition chamber;

(a) flowing trimethylsilane to the chamber and flowing inert gas to the chamber under conditions effective to chemisorb a first species monolayer comprising silicon onto the substrate, the inert gas flowing being at a first rate;

(b) after forming the first species monolayer, ceasing flow of the trimethylsilane to the chamber while flowing the inert gas to the chamber effective to purge trimethylsilane from the chamber;

(c) after purging the trimethylsilane from the chamber, flowing an oxidant and flowing the inert gas to the chamber under conditions effective to react the oxidant with the chemisorbed first species and form a monolayer comprising silicon dioxide on the substrate; the inert gas flowing during the oxidant flowing being at a second rate which is less than the first rate;

(d) after forming the silicon dioxide comprising monolayer, ceasing flow of the oxidant to the chamber while flowing the inert gas to the chamber effective to purge oxidant from the chamber; and

successively repeating said (a)-(d) flowings effective to form a silicon dioxide comprising layer on the substrate.

22. The method of claim 21 wherein the inert gas flowing while purging trimethylsilane is at the first rate.

23. The method of claim 21 wherein the inert gas flowing while purging oxidant is at the first rate.

24. The method of claim 21 wherein the inert gas flowing while purging trimethylsilane is at the first rate, and the inert gas flowing while purging oxidant is at the first rate.

25. The method of claim 21 wherein each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 2 Angstroms.

26. The method of claim 21 wherein each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 3 Angstroms.

27. The method of claim 21 wherein second rate is no more than 50% of the first rate.

28. The method of claim 21 wherein second rate is no more than 40% of the first rate.

29. The method of claim 21 wherein second rate is from 25% to 40% of the first rate.

30. The method of claim 21 wherein second rate is from 30% to 40% of the first rate.

31. The method of claim 21 wherein second rate is from 35% to 40% of the first rate.

32. The method of claim 21 wherein the oxidant is flowed to the reactor at a rate of at least 2000 sccm.

33. The method of claim 21 wherein second rate is from 35% to 40% of the first rate, each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 3 Angstroms, and the oxidant is flowed to the reactor at a rate of at least 2000 sccm.

34. The method of claim 21 wherein the oxidant flowing is void of plasma within the chamber.

35. The method of claim 21 wherein the (a) flowing is for a first time period and the (c) flowing is for a second time period, the second time period being longer than the first time period.

36. The method of claim 35 wherein the second time period is at least twice as long as the first time period.

37. The method of claim 35 wherein the second time period is more than 2.5 seconds, and the first time period is no greater than 2.5 seconds.

38. An atomic layer deposition method of forming a silicon dioxide comprising layer on a substrate, comprising:

positioning a substrate within a deposition chamber;

flowing trimethylsilane to the chamber under conditions effective to chemisorb a first species monolayer comprising silicon onto the substrate;

after forming the first species monolayer, flowing an oxidant to the chamber under conditions effective to react the oxidant with the chemisorbed first species and form a monolayer comprising silicon dioxide on the substrate; the oxidant being flowed to the chamber at a flow rate of at least 2000 sccm; and

successively repeating said trimethylsilane and oxidant flowings effective to form a silicon dioxide comprising layer on the substrate.

39. The method of claim 38 wherein the oxidant flow rate to the chamber is at least 3000 sccm.

40. The method of claim 38 wherein the oxidant flow rate to the chamber is at least 4000 sccm.

41. The method of claim 38 wherein the oxidant flow rate to the chamber is at least 5000 sccm.

42. The method of claim 38 wherein the oxidant is a mixture of O_3 and O_2.

43. The method of claim 38 wherein the oxidant flowing is void of plasma within the chamber.

44. The method of claim 38 wherein the oxidant is a mixture of O_3 and O_2, and is void of plasma within the chamber.

45. The method of claim 38 wherein each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 2 Angstroms.

46. The method of claim 38 wherein each of the silicon dioxide comprising monolayers is formed to an average thickness of at least 3 Angstroms.

47. The method of claim 38 wherein said trimethylsilane flowing is for a first time period and said oxidant flowing is for a second time period, the second time period being longer than the first time period.

48. The method of claim 47 wherein the second time period is at least twice as long as the first time period.

49. The method of claim 47 wherein the second time period is more than 2.5 seconds, and the first time period is no greater than 2.5 seconds.